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TECHNOLOGY ASSESSMENT OF FUTURE INTERCITY PASSENGER TRANSPORTATION SYSTEMS

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Volume 7
Study Recommendations

TECHNOLOGY ASSESSMENT OF FUTURE INTERCITY PASSENGER TRANSPORTATION SYSTEMS

VOLUME 7

STUDY RECOMMENDATIONS

Prepared by

A TECHNOLOGY ASSESSMENT TEAM

Peat, Marwick, Mitchell & Co.
University of California
Stanford University
Gellman Research Associates, Inc.
Science Applications, Inc.

Prepared for

National Aeronautics and Space Administration
and
U.S. Department of Transportation

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A management group for the project consists of representatives of:

NASA, Ames Research Laboratory

NASA Headquarters, Office of Aeronautics and Space Technology

DOT, Office of the Assistant Secretary for Systems Development and Technology

DOT, Transportation Systems Center

The views and conclusions presented in this report are those of the staff of the Technology Assessment Team and do not necessarily reflect those of NASA or DOT.

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I. INTRODUCTION

This technology assessment study was sponsored jointly by the National Aeronautics and Space Administration (NASA) and the U.S. Department of Transportation. The goals of the study, as developed by the NASA/DOT Oversight Committee for the project, can be expressed as follows:

1. To assess the impacts of new transportation technologies on society and to identify potential problems, drawbacks, and advantages of individual technologies.

2. To identify research and analysis tasks to alleviate negative impacts, to augment positive impacts, or to better understand the impacts produced by the potential introductions of the technologies.

The second of these goals is the subject of this volume of the study's final report.* It provides the project team's recommendations on research and analysis efforts which have resulted from the technology assessment. Many of the recommendations apply to the future supply of intercity passenger transportation services, categorized by mode. Other recommendations pertain to broad issues in intercity transportation--e.g., finance, regulation, traveler values--that will affect all modes.

Project Approach

The development of study recommendations drew from all tasks of the technology assessment. This 13-month project had a very broad scope--encompassing all of intercity passenger transportation and interactions with freight service--and a primary thrust was to explore a wide variety of possible future settings in which intercity systems would operate. The study tasks are briefly reviewed below to provide a perspective for the recommendations which resulted.

Issues. An early study task which continued throughout the project was the preparation of papers focusing on social, political, institutional, and economic mechanisms which will influence the way that transportation technologies will evolve and be placed in service.

Transportation Technology. Descriptions were prepared on the future performance characteristics of present intercity modes (air, rail,

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*See Appendix B for a list of other volumes.

highway) and possible new technological forms of transportation (e.g., tracked levitated vehicles).

Scenarios. Transportation innovations were postulated and analyzed for the year 2000 in the context of four different background settings. The settings included substantial variations in assumed societal goals, political mechanisms, economic conditions, and levels of resource availability.

Workshop. At the midpoint of the study, the project team and a group of 40 invited study participants* met to identify and assess impacts related to future transportation options. The participants included representation from government, industry, and academic and other institutions.

Impact Assessment. Based on the Workshop and other study task results, descriptions were prepared on the consequences that might occur if certain technological developments take place in intercity transportation. Possible indirect as well as direct impacts were addressed.

Nature of Recommendations

The study approach led to the identification of a large number of possible consequences of technological developments that may occur in intercity transportation. Some of these impacts are well understood and are seen as likely. Consequences of this kind are the basis for study recommendations regarding the characteristics of future intercity transportation modes. Many other possible impacts are only hazily perceived and their likelihood is questionable. In these instances, study recommendations are oriented toward further research and analysis activities

While many explicit and implicit recommendations on possible research and technology efforts are contained in the documentation of this study, the project team has chosen to highlight a limited number of these possibilities (Chapters II through XIV). In the judgment of the project team, the highlighted recommendations relate to *significant* issues or impacts, with important implications for the quality of future intercity transportation; and have *high leverage*, that is, they are believed to offer promising avenues of attack toward providing substantial improvements in intercity transportation.

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*Study participants also contributed to the project before and after the Workshop by reviewing draft study reports. See Appendix A for their comments on a draft of this report.

In accordance with study guidance, the recommendations describe what should be done but generally do not identify who should sponsor and/or perform the work, except in those instances where it is central to the recommendation. Also, neither priorities for the recommendations nor detailed work statements were requested by the study's sponsors.

II. SUMMARY

The recommendations on further research and analysis tasks which the project team has chosen to highlight are described in Chapters III through XIV of this report and are summarized in Table II-1, following.

Chapter XV contains a sampling of other recommendation topics that can be drawn from study documentation and Chapter XVI sets forth project team findings and recommendations which relate to the process of technology assessment.

Table II-1

SUMMARY OF HIGHLIGHTED RECOMMENDATIONS

Intercity Automobile Transportation

- Pursue an expanded program of propulsion system and vehicle design development to improve fuel economy.
- Undertake a technology assessment study of impending technological and institutional changes to the automobile.

Intercity Bus Service

- Undertake case studies to identify and test ways to improve services and facilities and to provide better integration of bus services with those of other modes.
- Assess regulatory policies affecting bus operations, including an investigation of means to increase bus service to small towns and rural areas.

Aircraft and Air Service

- Continue aircraft R&T (basic research and technology development) emphasizing measures to reduce cost, fuel consumption, and noise. Undertake study of mechanisms to hasten implementation of these developments.
- Continue to conduct systems analyses of changes in aircraft scheduling, routing, and operations, considering a range of future aircraft sizes and technologies.
- Investigate the possibilities of applying ongoing STOL aircraft technology efforts to Short Runway Aircraft (SRA) systems.

Table II-1 (cont.)

Airport and Air Traffic Control (ATC) Capacity Improvements

- Undertake a study to resolve uncertainties on features of future generations of the ATC system (beyond the Upgraded Third Generation ATC System).
- Undertake a program of airport landside improvement research, coordinated with ongoing airside work.

Rail (Fixed Guideway) Systems

- Analyze the benefits and costs of existing AMTRAK services, on a route-by-route and systemwide basis in relation to other modes.
- Emphasize technology and systems evaluations of improved (high-speed) passenger train service in specific corridors. Also, conduct technical studies to address currently perceived negative characteristics of very-high-speed (tracked levitated vehicle) systems, such as safety and noise.

Electric/Automated Highways

- Develop technical and economic data on electric/automated highway system options.
- Undertake a systems study of identified options after technical data have been developed.

Access/Egress and Intermodal Transfer

- Establish a continuing program of study and experimentation to improve access/egress and transfers, encompassing all intercity modes.
- Identify roadblocks to the successful implementation of multimodal terminals.

Table II-1 (concluded)

Energy and Materials

- Pursue a program of research and technology development for all modes to improve the fuel efficiency of intercity transportation vehicles.
- Continue research on new materials for transportation vehicles, with techniques for disposal and recycling of these materials as an integral concern.

Traveler Values and Preferences

- Continue studies to develop improved information on traveler preferences, including the importance of comfort, convenience, and personal security relative to perceived cost and travel time.
- Determine the feasibility an expanded and more detailed data base on intercity travel by city-pair.

Transportation Finance

- Develop improved estimates of the short- and long-term financing requirements of intercity transportation modes.
- Identify and evaluate funding mechanisms for transportation system maintenance and improvement that accommodate technology substitution and that use public funds to stimulate private investment.

Institutional Impacts

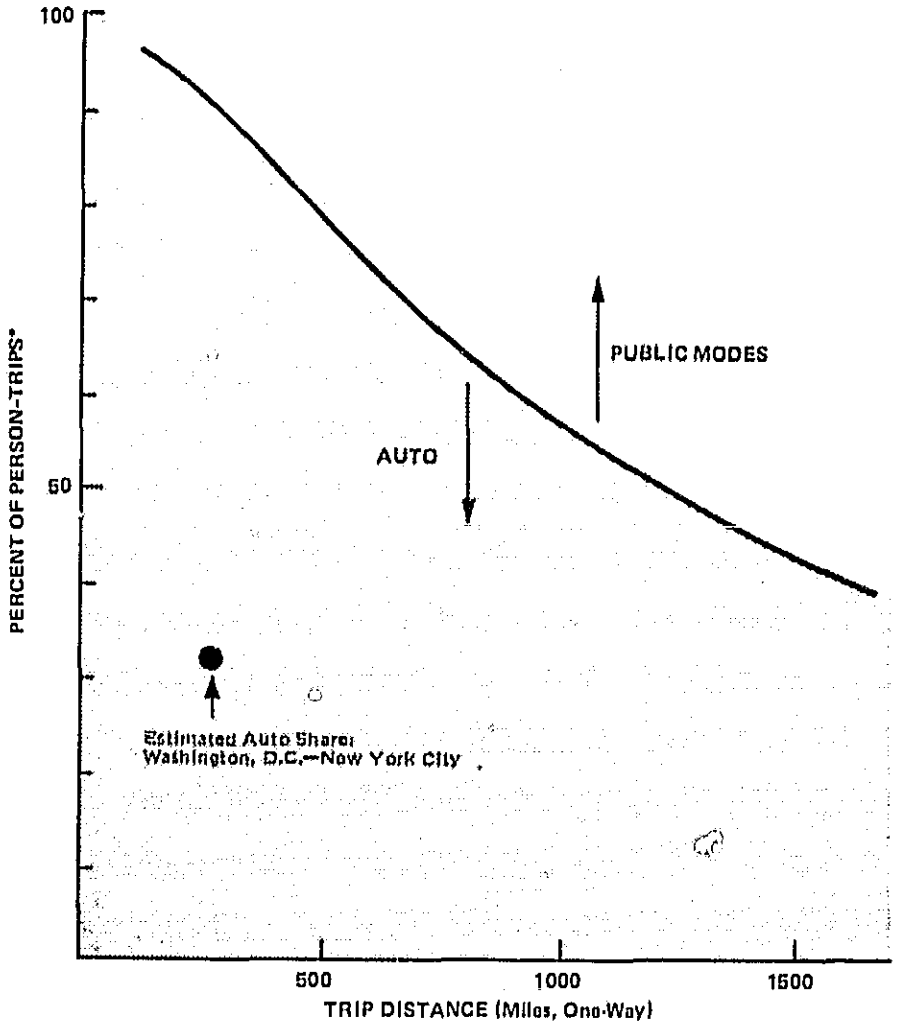
- Develop methods to appraise the impacts of institutional forces on technology delivery (methods comparable to those used in preparing environmental impact statements).

Regulatory Controls

- Develop improved techniques to analyze the effects of alternative economic, environmental, and safety regulations on levels of intercity service, transport industry structure, and technology development and implementation.

III. THE AUTO IN THE FUTURE

The automobile is currently the dominant mode of intercity travel--overall, 86% of intercity passenger-miles are by auto.* As trip length increases, the auto share of intercity trips declines, as shown in Figure III-1.



Source: An approximation developed from data in the *National Travel Survey, Census of Transportati* ., (1967, 1972).

Figure III-1. INTERCITY AUTO TRAVEL AS A PERCENT OF TOTAL TRAVEL

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*TAA, *Transportation Facts and Trends*, 1974.

The dominance of auto travel arises from a variety of factors, including low perceived cost and great flexibility and convenience of service relative to public modes. Nevertheless, limited available data show that the dominance of the auto is considerably lessened in specific markets where a high level of public transportation service is provided. (As shown in Figure III-1, for New York-Washington, D.C., the market share for the auto* is considerably less than the national average for that trip distance.)

Findings

The auto/highway system constitutes both a major "investment"--economic, institutional, and social--and the principal "leverage point" for effecting desirable changes in the impacts of intercity transportation.

Patronage analyses conducted in this study** indicate that the auto will continue to be the dominant mode of intercity travel in a variety of possible settings to the year 2000. These settings include a range of conditions that are especially adverse to the auto, including very high energy prices and substantial advances in the relative performance of competing modes (air, bus, high-speed fixed guideway). The numerical analyses are inconclusive, however, because they do not take into account several factors raised by study issue papers and Workshop discussions.

Recently, there has been a trend toward the purchase of somewhat smaller vehicles, largely in an attempt to negate higher energy costs. To the extent that this trend continues (or accelerates) and to the extent that smaller cars are more widely considered to be less comfortable or less safe than their predecessors, intercity auto travel may decline. A study issue paper*** suggests that behavioral changes may take place--the auto may be looked on less as an object of ownership pride and more as simply one of several alternative means of transport.

Workshop deliberations indicate that a segment of society views the automobile as an evil that should be replaced at any cost--it is energy-inefficient, not available to all who wish to travel, unsafe, and pollutes the environment in terms of emissions and adverse land-use impacts.

A majority view is that the auto provides many desirable service features and that incremental improvements in vehicle technology can minimize the adverse impacts of intercity auto use. However, considerable time and money will be required to provide the innovations to simultaneously improve fuel economy, reduce emissions, improve crashworthiness, increase the useful life, and hold the line on vehicle prices. The stakes are great

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*Study estimate.
**Volume 4.
***By Mollenkopf in Volume 2.

for reducing energy consumption, inasmuch as the auto consumes about one-third of the total petroleum energy. Assuming necessary technological developments and continued pressure to meet ever stricter energy conservation and environmental goals, one of several promising alternative auto engine technologies* may generally replace the conventional gas-powered internal combustion engine, perhaps during the 1980's. The timing of this changeover depends upon the skill with which critical components research is conceived and pursued in the next decade; the extent to which government actions recognize and channel the manufacturers' profit motives and capabilities to accelerate socially desirable change; and the success with which a host of affected secondary suppliers--the oil companies, auto maintenance and road service firms--and their personnel are helped through the transition. These secondary suppliers would incur large expense and experience obsolescence in facilities and skills during changeover.

It is also possible that future breakthroughs in electrical generation, transmission, and storage may some day result in a transition to heavy use of electric automobiles. (This major change could take place simply to conserve petroleum.) In such an eventuality, the effects on secondary suppliers would be far more serious than with the less profound transition to alternative combustion engines. The premium on reduced weight in electric vehicles, since some running must be done using batteries or other storage devices, would create the need for light, inexpensive, safe, and recyclable materials.

All in all, the future of automobile technology development contains a number of dramatically different outcomes.** Possible but not inevitable outcomes include the emergence of separate (short range) urban and (long range) intercity automobile fleets; serious problems of road safety, due to wide variations in vehicle size and performance; adverse impacts on automobile maintenance and service firms and their employees; various environmental and energy conservation consequences; and differential service and income effects on various segments of society. The need to pursue desirable hardware development paths, as well as impact assessments, is clear; the strategy for doing this is currently hazy.

Recommendations

Pursue a greatly expanded program of research and technology development for propulsion systems and vehicle design with the objective of improving fuel efficient and nonpolluting alternatives to the present automobile. A key to the expanded program is careful coordination of publicly supported efforts and automobile manufacturers' efforts. Public efforts should emphasize high-risk basic research and monitoring the rate of technological improvements in energy efficiency in order to advise control agencies when more exacting pollution standards and fuel economy standards should be applied.

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*See Volume 3.
**See Volume 6.

Undertake a technology assessment focused specifically on impending technological and institutional changes to the automobile. Immediate concerns include the safety impacts of changing fleet size and performance mix, the effects of possible changes in the buying patterns of new cars versus old, and upcoming changes in vehicles and their fueling methods to meet environmental standards. Longer-range concerns include the impacts of alternate automobile engine technologies on the industry, labor and the economy. The automobile technology assessment effort should draw upon the results of recent and ongoing analysis efforts (e.g., The Interagency Task Force on Motor Vehicle Goals Beyond 1980).

IV. IMPROVED INTERCITY BUS SYSTEMS AND SERVICE

Intercity bus travel is usually both slower and more costly than travel by private automobile. (See Figure IV-1.) Compared with other common-carrier modes--air and rail--intercity bus service is generally slower but fares are lower. (See Table IV-1.) These comparisons suggest that a primary market for scheduled intercity bus service consists of travelers who cannot use an automobile and cannot afford or do not wish to pay the higher fares of air or rail service. Intercity bus service currently accounts for a relatively small percentage of intercity travel of over 100 miles. (Table IV-2). However, for many small communities, the bus is the only intercity common-carrier mode available (Table IV-3).

Findings

To the extent that intercity bus service can be improved (relative to other modes) there is potential for important positive impacts. Foremost among these potentials are reduced energy consumption for intercity travel and increased mobility to residents of small towns and rural areas and others who travel on low-density routes.*

Intercity bus service is substantially more energy-efficient than other modes (Table IV-4); an existing infrastructure (highways) is used; and services are amenable to incremental improvement, affording high flexibility to respond to policy changes as well as growth in demand.

Bus service, in its current form, appears to have a number of problems that inhibit patronage. These include unaesthetic and perhaps threatening environments at terminals for some travelers, difficulties in terminal access and intermodal transfers (or transfers between bus lines), uncomfortable seating, and infrequent service. Regulatory and institutional problems and safety concerns have thwarted some identified means of improving intercity bus service; for example, there is continued opposition to the introduction of wider intercity buses to achieve increased traveler comfort.**

Recommendations

Undertake a program to identify and test means of improving intercity bus service. The program should be sponsored at the federal

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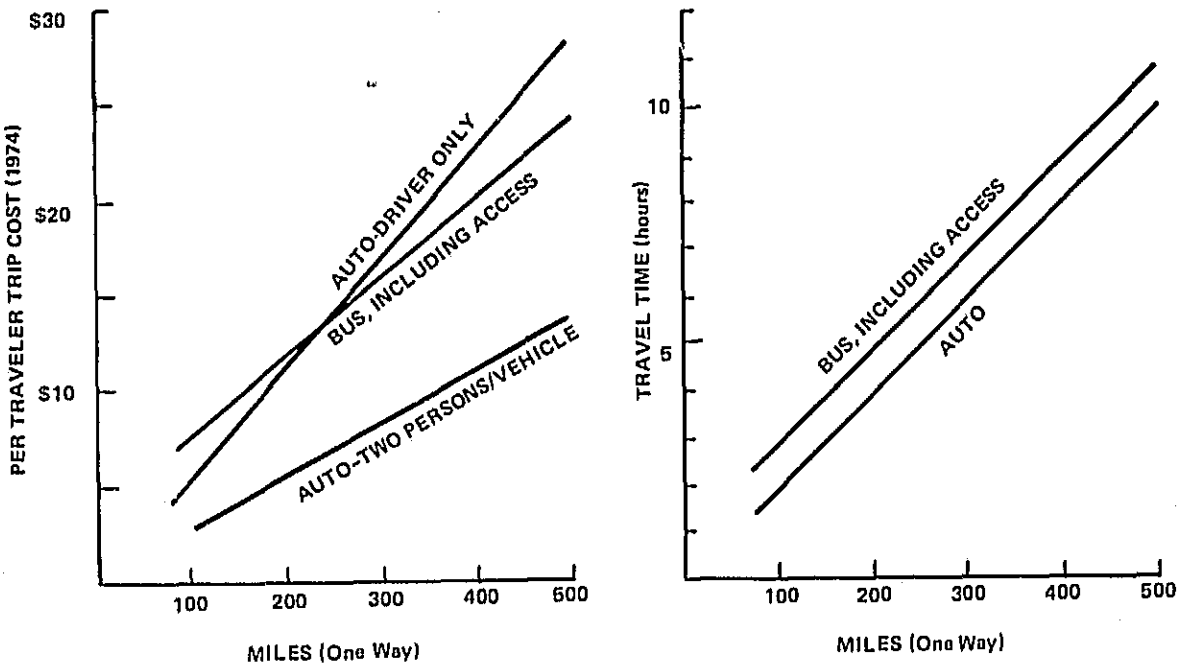
*See Volume 6.

**At 8 feet wide, intercity buses are generally 6 inches narrower than intracity buses. A 10-inch increase in intercity bus width would widen seats by about 2 inches. This is roughly the same increase in seat width as has been achieved in the transition from narrow to widebody aircraft--a change that has been met with substantial acclaim.



Source: Volumes 3 and 4.

Figure IV-1. REPRESENTATIVE COSTS AND TRAVEL TIMES FOR AUTO AND INTERCITY BUS TRIPS

Table IV-1

REPRESENTATIVE FARES AND BLOCK-SPEEDS FOR BUS, RAIL, AND AIR

	Fare in Cents per Passenger-Mile[a]	Block-Speed in Miles per Hour[b]
Bus	4.4¢	50
Rail	5.8	57
Air (Coach)	6.9	510

a. TAA, *Transportation Facts and Trends*, 1974.
b. Volumes 3 and 4.

Table IV-2

PERCENTAGES OF INTERCITY COMMON-CARRIER TRAVEL BY MODE 1972

Measure of Intercity Travel	Rail	Bus	Air	Other	Total
Person-Trips[a]	4%	13%	77%	6%	100%
Passenger-Miles[b]	5	16	76	3	100
Carried Passengers[b]	27	62	11	0	100

a. *U.S. Census of Transportation* (does not include trips of less than 100 miles, one-way).
b. TAA, *Transportation Facts and Trends* (includes trips of less than 100 miles).

Table IV-3

PERCENTAGE OF CITIES WITH DIRECT INTERCITY PASSENGER SERVICE[a]

City Population	Intercity Bus Service	Scheduled Air Carrier or Commuter Air Service	Rail Service
2,500 to 5,000	95%	15%	5%
5,000 to 10,000	100	70	20
10,000 to 25,000	100	80	25
25,000 to 50,000	100	85	40
50,000 to 250,000	100	100	45

a. Based on a sample of cities.

Source: DOT, *1974 National Transportation Report.*

Table IV-4

COMPARATIVE ENERGY EFFICIENCY

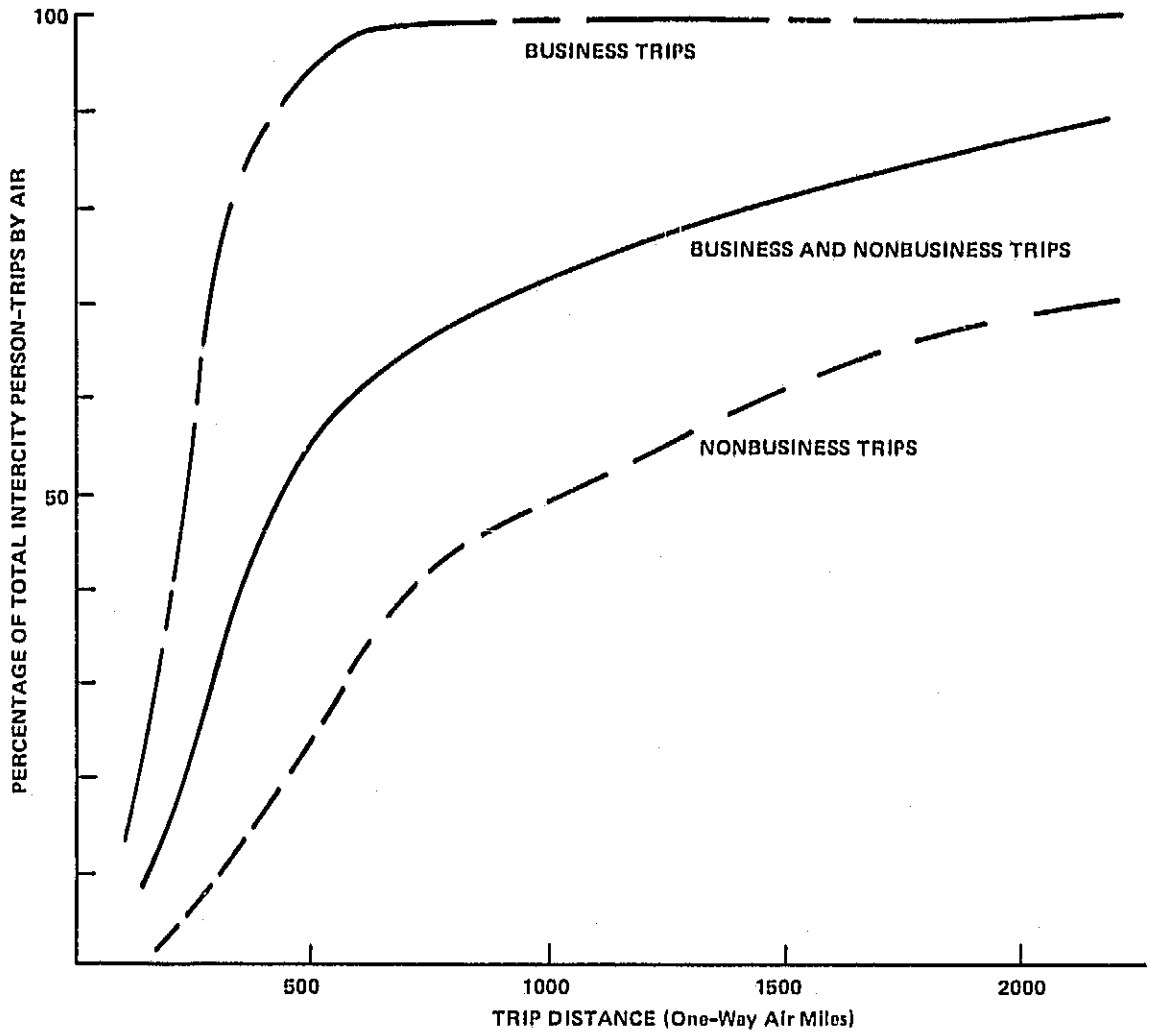
	Thousands of Btu per Passenger-Mile
Auto (full-sized)	2.3
Bus (diesel)	0.7
Rail (metroliner)	1.0
Air (DC-9 at 500 miles)	4.2

Note: 60% load factor assumed for all modes.

Source: Volume 3.

level and include state involvement. It should also work closely with equipment manufacturers and bus companies in a continuing exploration of possible vehicle changes. A series of case studies should expand on existing research knowledge to improve bus transportation, such as seeking innovative ways to improve bus stations and to provide better integration of bus services with those of other modes. In direct support of these studies, an evaluation is needed of public attitudes and user choice factors influencing bus patronage. An interagency-sponsored study should appraise federal and state regulatory policies on bus operations, identify and evaluate impacts that would result from changes in these policies, and explore the economics of and financial mechanisms for increasing bus service to small towns and rural areas.

Available data indicate that air travel is now the dominant mode of intercity transportation in many city-pair markets of over 500 miles. (See Figure V-1.)



Source: Volume 4.

Figure V-1. MARKET SHARES FOR AIR TRAVEL
(From Data for Selected City-Pairs)*

*Note that these results differ from the nationwide aggregates of the National Transportation Survey, Census of Transportation. (Figure III-1).

In this study, a number of potential technological developments and other innovations were investigated that could alter the attractiveness of air travel relative to other common-carrier modes and the automobile. Postulated advances in air technology* included:

- Advanced technology subsonic transports to achieve marginally higher speeds *or* substantial (30%) reductions in fuel consumption and lesser reductions in direct operating costs (via improved airfoils, composite materials to reduce structural weight, and modest propulsion efficiency gains).
- Domestic air service at supersonic speeds.
- Small aircraft for low-density travel markets.
- High-performance short runway aircraft capable of using "close-in" airports to serve short-haul markets.

The context for these investigations included the possibility of much improved surface transportation, postulated changes in transportation regulation, and different future settings in terms of such factors as per capita income and energy price levels.

Findings for Long-Distance Air Travel

Conventional aircraft service is expected to continue in the future as the dominant public mode for long-distance travel. The obvious advantage of air service relative to its major competitor, the automobile, is speed of travel. Negative characteristics of current services include fares and energy consumption at the high end of the intercity transportation spectrum and noise in the vicinity of airports.

It is a consensus of those who participated in the study that what is needed most are technologically improved versions of current conventional aircraft with the emphasis on achieving greater energy efficiency, reduced costs, and less noise rather than increased speed. These aviation technology improvement efforts should continue to be pursued by a combination of development programs of current airframe and engine manufacturers augmented by government research and technology programs aimed at high-risk areas of potential improvements.

The current low levels of growth in airline traffic relative to growth of the 1960s, a lowering of long-term air traffic growth forecasts, and the possibility of substantial changes in the future economic regulation of air carriers have created greater than normal uncertainty regarding future capabilities to develop and purchase new aircraft. This climate

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*See Volumes 3 and 4.

is undoubtedly caused to some extent by the recently low levels of general economic growth. It may also be true, however, that the industry is "maturing" (approaching market saturation). To the extent that this is true, delays in the introduction of advanced technology aircraft can be anticipated.

Travel demand analyses in this study indicate a significant market potential for improved supersonic aircraft (in part, because only a relatively low fare premium of 30% was assumed).* Positive impacts include increased mobility and enhancement of national prestige. The clear negative impacts are noise and high energy consumption. Political and institutional barriers are also foreseen by Workshop participants. Political support will be difficult to assemble for the high cost of developing an SST that serves only a limited segment of all travelers.

Findings for Short-Distance, Low-Density Air Travel

Commercial aviation has experienced financial difficulties in providing high quality air service to short-haul travel markets with low traffic densities.** These markets include direct air services between smaller communities and feeder services between small and large communities. A primary reason for the limited success is that carrier costs rise sharply as aircraft size and range decrease. Regional and trunk airlines naturally tend to concentrate on higher-density markets and the result is aircraft fleets and operating patterns that are mismatched to small markets. While small firms (i.e., commuter airlines) can fit their fleets and operations to low-density services, these carriers have comprised an unpredictable and, therefore, unattractive market for aircraft sales. If these problems are overcome and a new generation of small aircraft (10- to 20-seat) is introduced, economic development of smaller communities could be substantial. However, small-aircraft services would increase flight operations, and air traffic control problems might increase at the major airports included in the network of small aircraft services.

Findings for Short-Distance, High-Density Air Travel

Short runway aircraft (SRA) systems were postulated in this study as a means of improving air service in short-distance, high-density travel corridors. The concept is that nonstop air services would be provided among a network of satellite airports. These airports were assumed to be located closer to large population centers than existing major airports, with runways in the 3,000- to 5,000-foot range. This range was selected for analysis rather than STOL-length runways (nominally 2,500

*See Volume 4.
**See Volume 6.

feet or less) because aircraft energy consumption and operating costs decrease significantly as design runway length is increased from 2,000 to 5,000 feet.*

Travel demand analyses** indicated that the SRA systems would be heavily patronized, primarily because of savings in the time and cost of airport ground access. In addition to this benefit to air travelers, SRA systems might also relieve congestion at long-haul airports. It is emphasized, however, that the future availability of appropriate sites for SRA airports was a study assumption. Surveys were not made to determine where SRA (or STOL) airports might be located near large population centers.

Recommendations

Continue aircraft research and technology, emphasizing developments leading to reduced cost, fuel consumption, and noise. Among these are improved airfoils, composite materials (including demonstration of use of large composite structures), propulsion improvements, reduction of other (nonengine) sources of noise (i.e., aerodynamic noise) and active controls.

Undertake a study of the mechanisms for the introduction of new aircraft technology into commercial use. The study should include an appraisal of government financial and tax policies to encourage more rapid implementation. For example, an assessment should be undertaken on the near-term impacts of the current government program to develop quiet aircraft engines. The study should evaluate not only environmental impacts on a national scale but also the economic impact on engine manufacturers and financial constraints that the airlines might face in attempting to acquire the technology on a priority basis.

Continue to conduct systems analyses of changes in aircraft scheduling, routing, and operations with the aim of reducing costs and fuel consumption while maintaining or improving air service. These studies should consider a range of future aircraft sizes and technologies, as well as the impact of changes in industry regulation.

Consideration should be given to expanding the scope of ongoing STOL aircraft technology efforts to encompass SRA systems. That is, the possibility of applying STOL technology to short runway aircraft should be explored as a means of achieving reductions in forecast energy consumption and operating costs. The availability of suitable SRA airport sites in high-density travel corridors requires investigation.

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*See Volume 3.
**See Volume 4.

VI. AIRPORT AND AIR TRAFFIC CONTROL CAPACITY IMPROVEMENTS

Recent forecasts of aviation growth have indicated lower rates of growth than those forecast in the late 1960s and early 1970s. For example, the FAA's forecast of 1980 passenger enplanements made in 1970 was 415 million; by 1975, the 1980 forecast had dropped to 252 million. The FAA's forecast of the general aviation fleet for 1980 was 225,000 in 1969, and 189,000 in 1975. Forecasts of the more distant future have also declined. In spite of the lower forecasts, substantial increases in passenger traffic and in aircraft operations are still foreseen for both commercial and general aviation, thus creating the continued need for more airport and air traffic control capacity.

Findings

To accommodate future increases in aircraft operations and to increase safety, the FAA is striving to implement the Upgraded Third Generation (UG3RD) Air Traffic Control (ATC) System,* with progress influenced by budgetary constraints. The Study Team found that questions exist among aviation interests concerning the timing of required capacity improvements to the ATC system (primarily because of uncertainties in the future growth of general aviation aircraft operations). Questions also exist concerning the cost-effectiveness of various proposed system features; that is, regarding their incremental contributions to safety and capacity versus their incremental costs. Although the FAA has undertaken an evaluation of the UG3RD, a high degree of uncertainty exists on the ATC improvements that should occur beyond those encompassed by the UG3RD.

Increasing financial, environmental, and institutional problems regarding airports in recent years have strengthened the view that emphasis in providing for commercial aviation growth should be on maximizing the capability of existing airports, rather than on large-scale expansions or building new airports.

Forecasts of air carrier aircraft operations include a continuing evolution of the fleet toward larger aircraft. On the airside, this evolution will increase the problem of wake vortices which, until solved, requires substantial spacings between standard-body and preceding wide-body aircraft on both takeoff and landing, thereby limiting aircraft throughput. A potentially more serious impact of the evolution to large aircraft and increases in passenger traffic will be stresses placed on the airport landside (i.e., terminal buildings, parking, and airport access roads). While substantial research studies have been conducted under FAA auspices regarding alternatives for airfield improvements, relatively little effort has been devoted to landside research. Federal

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*See Volume 3.

responsibility for landside research on terminal buildings and airport parking appears to rest solely with the FAA; however, there is no continuing, coordinated, comprehensive program responsibility in the federal government for airport access/egress.

Recommendations

Undertake a study to resolve uncertainties on necessary or desirable features of future generations of the ATC system, based on a comprehensive review of the effectiveness and costs of components of the Upgraded Third Generation ATC System.*

A program of airport landside improvement research should be undertaken and closely coordinated with ongoing airside work. The objective of the program would be to develop, in cooperation with airport sponsors and users, planning methodology and guidelines for airport landside improvements. Case studies of a number of representative airports should be undertaken, evaluating passenger and baggage processing improvements, both in capacity and efficiency. A desirable by-product of these studies would be planning guidance of potential use for other types of terminals (e.g., bus and rail stations).

*This effort should draw on efforts that are now under way within FAA/DOT.

VII. FUTURE POTENTIALS OF RAIL (FIXED GUIDEWAY) SYSTEMS

Intercity rail patronage (passenger-miles) has increased since formation of AMTRAK and the introduction of Auto-Train. However, the rail share of total intercity travel is low (Figure VII-1), and operating expenses continue to exceed operating revenues by a wide margin, requiring a substantial direct federal subsidy (Figure VII-2). In 1975, Congress authorized $1.1 billion in grants and loan guarantees to AMTRAK to sustain service through 1977.

In this study, changes in conventional intercity rail passenger service (AMTRAK) were postulated and analyzed.* Both service improvements and discontinuances were investigated for city-pair trips of varying distances. In addition, two other types of fixed guideway technology were examined for selected corridors,** in the year 2000:

- Improved passenger train service (IPT) with block-speeds of 110 miles per hour,
- Tracked levitated vehicle systems (TLV) with top speeds of 350 miles per hour and block-speeds of 300 miles per hour.

The settings for these analyses included varying levels of improvement or degradation to other intercity modes.

Findings

Both study analyses and workshop opinions suggest that the negative impacts would be small if conventional rail service was discontinued on long-distance, low-density routes (i.e., outside high-density travel corridors). This viewpoint holds that other common-carrier services (air and bus) are adequate, but does not account for the political considerations that have had pronounced effect on where AMTRAK service is now provided.*** Although a final evaluation of AMTRAK costs, performance, and patronage may be premature because improvement programs are now under way, the question of continued government subsidies for passenger rail service is of major importance.

For the travel corridors examined in this study (high-density markets of less than 500 miles), high-speed IPT rail service appears attractive

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*Volume 4.

**The three corridors examined were: (1) Boston-New York-Washington, (2) Chicago-St. Louis, and (3) Seattle-Portland.

***For a "political history" of AMTRAK, see the paper by Jones and Miller in Volume 2.

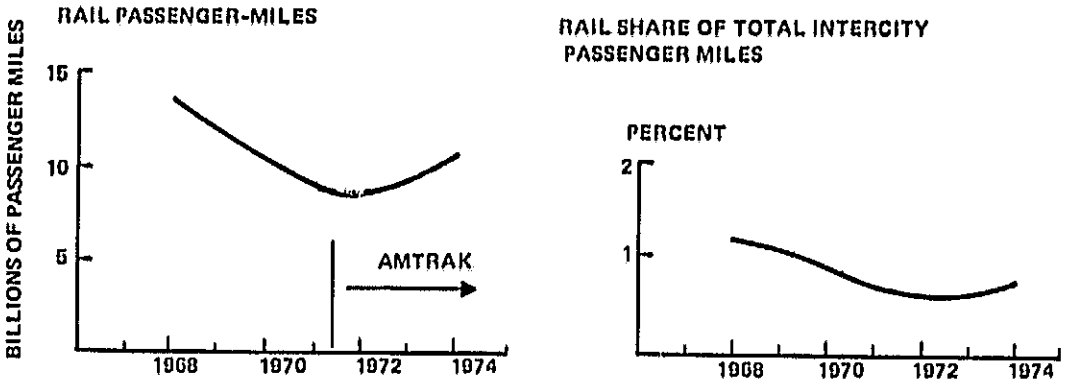


Figure VII-1. INTERCITY TRAVEL BY RAIL*

*Class 1 Rail, including AMTRAK and Auto-Train.
Source: TAA, *Transportation Facts and Trends*, 1974.

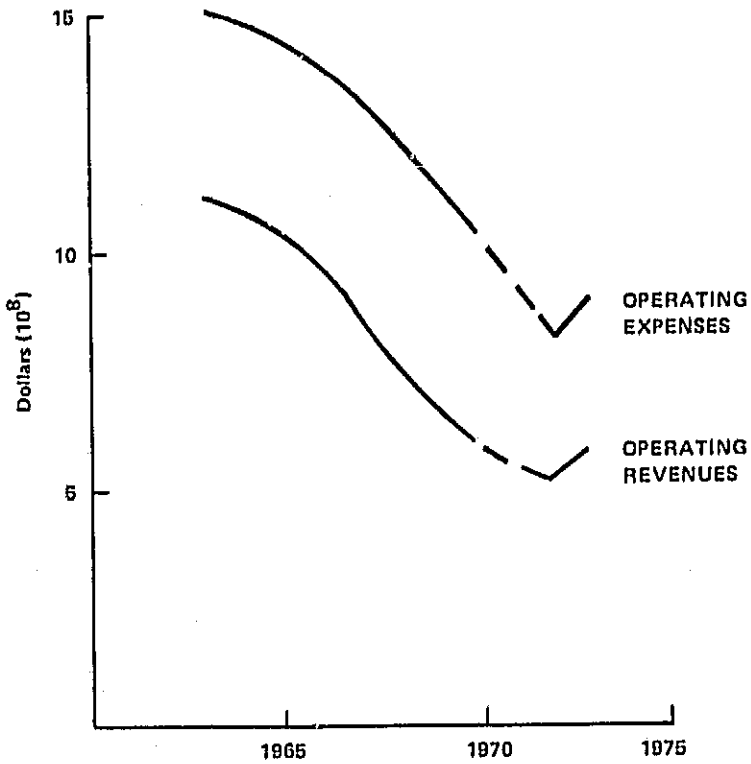
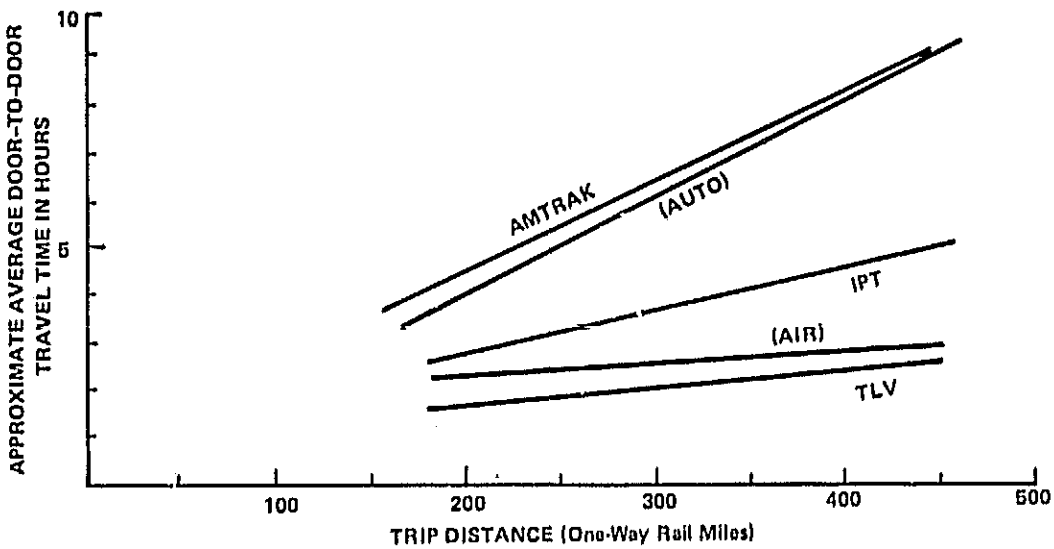


Figure VII-2. PASSENGER RAIL REVENUES, EXPENSES, AND INVESTMENT

Source: "Railroad Facts," Association of American Railroads, 1975.

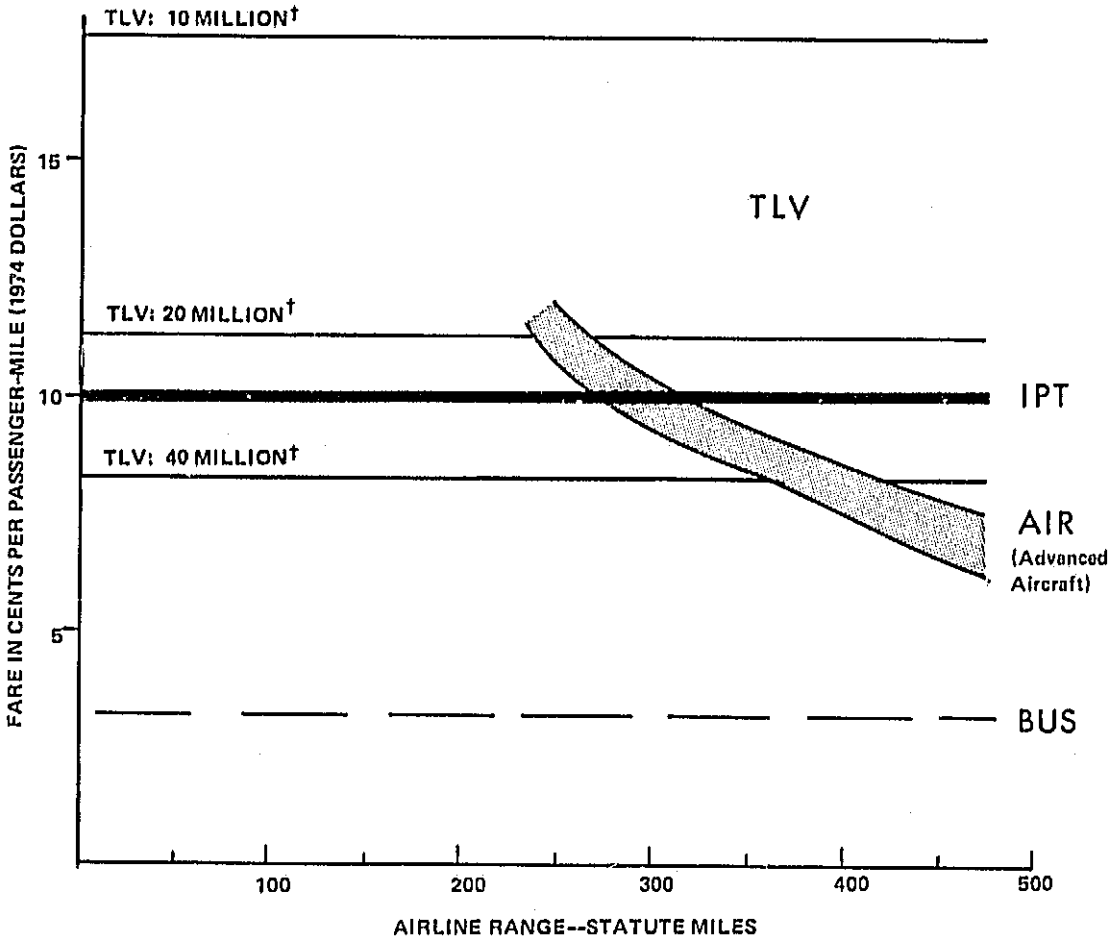
on the basis of several positive impacts. Door-to-door trip times and line-haul fares for IPT compare favorably with those for air service (Figures VII-3 and VII-4) and energy consumption is low. IPT service at the speeds postulated will require substantial upgrading of roadbed, but the services can be introduced incrementally. In some corridors, there may be sufficient trackage to allow for exclusive use of some lines by high-speed passenger trains. In other corridors, there may be a need for IPT to share existing roadbed with freight trains to avoid major commitments for new rights-of-way and signal systems. This situation may lead to high track maintenance costs (because of the effects of heavy freight trains) and degraded freight service (to the extent that freight trains are delayed on sidings while passenger trains pass).



Source: Volume 4 analysis for city pairs within corridors (Boston-New York-Washington, Chicago-St Louis, Seattle-Portland).

Figure VII-3. COMPARATIVE TRIP TIMES FOR FIXED GUIDEWAY TECHNOLOGIES

High-technology, tracked levitated vehicle systems are now looked on with serious misgivings of a financial, institutional, behavioral, and environmental nature. One major problem is the need to acquire new rights-of-way with minimal curvature to allow for the very high-speed service. A related major problem is the high capital cost of the



From Volume 3. Principal assumptions include:

- No subsidy
- 60% load factors
- Per-mile guideway costs of $11.2 million for TLV construction and $171,000 for upgrading IPT track.

†TLV traffic density (annual passenger-miles per route-mile).

Figure VII-4. COMPARATIVE LINE-HAUL FARE LEVELS FOR FIXED GUIDEWAY AND OTHER PUBLIC MODES

special guideways and the resulting need for high patronage for the systems to be financially attractive. High investment cost coupled with a very limited number of potential geographic applications raises doubts on political viability. There are a large number of unknowns regarding other impacts of very high-speed (300+ miles per hour) fixed guideway technology, including energy consumption, noise, safety, and traveler perceptions of comfort and security.*

Recommendations

The benefits and costs of existing AMTRAK services should be analyzed on a route-by-route and systemwide basis, in relation to other modes, to assist in decision-making on changes to the AMTRAK route structure and the desirability of continuing government subsidy.

Emphasis should be given to technology and systems evaluations of improved passenger train service. Efforts should focus on ways to implement service as soon as practical in appropriate corridors (e.g., the Northeast) to capture potential energy savings. Questions related to noise, safety, and interactions with freight service need to be addressed in specific rail corridors.

Tracked levitated vehicle research studies should focus on aspects of the technology that are now of concern. These aspects include highway guideway construction costs, noise, and traveler perceptions of the service, including safety. Vehicle and guideway technology studies for TLV are of a high risk nature but component research should be undertaken to understand and perhaps resolve systems impact problems.

*See Volume 6.

VIII. ELECTRIC/AUTOMATED HIGHWAYS

"Electric highways" were one of the advanced technologies investigated in this study.* The concept is that vehicles--autos and perhaps buses and trucks--would be propelled by electrical power taken from a conductor imbedded in the highway lane. When not traveling on the electric highway network, the vehicles would be self-propelled by internal combustion engines or batteries. Also considered, as an adjunct or possible technical requirement, was automation of vehicle control while traveling on an electric highway. It was postulated that this automation could be achieved by the addition of low-cost control devices to vehicles. With or without electrification, automated highways are one kind of "dual-mode" system.**

Findings

Electric highways offer the possibility of dramatic reductions in fossil fuel energy consumption for intercity transportation, to the extent that nuclear or other nonfossil electrical generating capacity is available in the future. (At present, the prospects for such a generating capacity are uncertain.) An identified concern regarding electric highways is the potential effect on public health of strong electric/magnetic fields developed in the transmission and transfer of energy from the guideway to vehicles.

Automation of electric highways could increase highway capacity for auto travel and would allow drivers to pursue other activities or rest while en route. Other potential positive impacts of automated highways include greater traveler mobility (miles per day). Negative impacts include adverse effects on roadside businesses such as motels.

For bus and truck transportation, electric/automated highways raise the possibility of multiple-vehicle tows ("highway-trains"), reducing labor requirements and possibly yielding significant savings in operating costs.

Overall, electric/automated highways offer a long-range opportunity for achieving operating convenience and economies and large mobility increases in intercity transportation. The technology seems to pass the critical tests of political constituency, incrementalism, and significant private sector involvement.***

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*Volumes 2 through 6.

**Dual-mode is defined as a system in which individual vehicles operate some of the time under their drivers' control and at other times under common control by a vehicle carrying conveyance (e.g., auto-train) or by a guidance system.

***See Garrison, Carter, and Jones and Miller in Volume 2.

Whether the technology can be made cost-effective remains to be seen. There are many technological uncertainties to be resolved, as well as serious safety questions (e.g., mixing controlled and uncontrolled vehicles, protection from vandals) and other problems. For example, standardized, reliable vehicles may be needed for the technology and require substantial regulatory control of vehicle manufacturer and maintenance.

Recommendations

Undertake a technical study to identify and evaluate electric/automated highway system options. The study should develop data on technical and economic feasibility for alternative propulsion and control subsystems, and on the power generation and transmission implications of widespread implementation. Development might be pursued to the stage of small-scale "laboratory" demonstrations of performance.

After required technical data have been assembled, a systems study of electric/automated highways should explore the identified options in detail. Considerations should include potential markets for intercity and urban travel, alternative implementation time frames, and energy and environmental impacts. Other important questions relate to safety (particularly during the lengthy implementation period when automated and nonautomated traffic would presumably share common highway rights-of-way), system reliability, regional development implications, effects on private sector equipment and vehicle suppliers, and effects on other modes. Costs and benefits should be identified for both potential users and nonusers of an automated highway system.

IX. ACCESS/EGRESS AND INTERMODAL TRANSFER

Access to and egress from public intercity transportation and transfers between modes can be time consuming and frustrating for travelers, especially for those who do not travel frequently. In terms of travel time, access and egress can account for a significant proportion of total door-to-door trip time, as indicated below.

Table IX-1

ACCESS/EGRESS TIMES

One-Way Trip Distance (miles)	Approximate Access, Egress, and Terminal Time As a Percent of Door-To-Door Travel Time	
	Bus and Rail	Air (nonstop flights)
150	25%	75%
300	15	65
500	6	55
1,000	4	45

Source: Volume 4 scenario analysis.

Findings

Solutions to access/egress problems are elusive.* Many organizations are engaged in the provision (and regulation) of access/egress services and gaps in service or suboptimization can result. For example, in the Chicago area, some intercity buses are not allowed to serve the airport.** There appear to be few commonalities among access/egress and intermodal transfer problems in different locations. Each case is heavily

*See "Current and Future Forms of Intercity Passenger Transportation" (Garrison), in Volume 2.

**See Overby and Best paper in Volume 5.

influenced by local history, geography, and settlement patterns, as well as regulatory precedents.

Lack of adequate information to travelers at the start of their trip about egress options at their destination may be an important reason for traveler dissatisfaction with this facet of intercity transportation.

The automobile can be expected to continue as a major mode for access because of convenient, flexible service for most travelers (e.g., personal auto at trip origin, taxi or rental car at destination). Auto traffic levels on urban highways generated by access travel will likely continue to constitute only a minor fraction of total vehicle traffic.* In this respect, access/egress is a small part of the urban highway problem. An obvious negative impact of heavy reliance on automobiles for access is traffic and parking congestion in the immediate vicinity of terminals--airport terminals in particular.

Proponents of better mass public transportation to terminals are many; yet, use of mass transit for intercity access/egress is confounded by the need for baggage handling. Also, it is recognized that if mass transit is to be successful in serving substantial numbers of access trips, it must provide both ubiquitous coverage of the urban area and direct service to intercity terminals.

To concentrate what would otherwise be diffuse access/egress trips and to facilitate intermodal transfer (e.g., rail to bus), the multimodal terminal concept has appeal.** In one form of this concept, the stations of intercity bus companies and rail passenger terminal facilities serving a city would all be under one roof, with direct public transit service to the airport. However, it is not clear that competing transportation companies would endorse this approach. Also uncertain are appropriate government roles in planning, financing, or operating a multimodal passenger terminal.

To achieve greater intercity travel convenience, there are proposals to treat access to intercity transportation as an inseparable part of the total trip, requiring formation of multimode access/line-haul/egress companies. However, the development of such services could give rise to major cross-subsidies from line-haul to access/egress, possibly drastically reducing the profitability of the overall system. Pessimistic outcomes include service reductions or a requirement for public funding to maintain previous line-haul service.

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*See Overby and Best paper in Volume 5.
**Panel 3, Volume 5.

Recommendation

Establish a continuing program of study and experimentation to improve access/egress and intermodal transfer for all intercity modes.* The program should include study of inexpensive changes to urban public transport services and vehicles to help meet intercity traveler requirements, terminal design and location options, and analysis of effective means to disseminate travel information. Reviews of recent studies of multimodal terminals should be undertaken with a view of identifying the major roadblocks to successful implementation. For the most part, this program should be case-specific (and conducted locally in cooperation with state and local governments and private operators), although a search for problem commonalities among different urban areas should be emphasized.

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*Responsibility at the federal level for access/egress research may need to be more clearly established before embarking on this program.

X. ENERGY AND MATERIALS

A significant proportion of domestic energy use is accounted for by transportation, in general, and intercity transportation, in particular. (See Table X-1.) The transportation sector also consumes significant amounts of other resources; for example, about one-quarter of annual steel production.

Findings

National energy policy will provide significant impetus to improve the fuel economy of intercity transportation vehicles. A large program of research and technology to improve the fuel economy of commercial aircraft has recently been approved. Programs have also been undertaken to improve the fuel efficiency of automobiles.

In the unlikely event that ways are not found to significantly improve transportation fuel economy, it will be most difficult to introduce improved intercity services (i.e., higher speeds, more frequent service), that require more energy than is consumed at present.

Long-term possibilities for electrification of intercity transportation is a common thread connecting a number of seemingly attractive technologies; for example, greatly expanded railroad electrification, electric autos, and electric highways. Widespread intercity use of these alternatives to petroleum consumption hinges on successful development and, in some cases, major breakthroughs in generation of electricity using nonfossil fuels, and distribution, storage (e.g., batteries), and power-pickup technologies.

High leverage possibilities for several intercity transportation technologies are associated with research on materials. Development of light but crashworthy highway vehicles at reasonable cost would be stimulated by materials development; a variety of aircraft efficiency and performance improvements are also dependent on lightweight composite materials.

Important issues related to future materials employed in transportation vehicles are: (a) and designed vehicle lives, (b) methods of disposal of worn-out vehicles, and (c) potential for recycling scrap materials.* The cost of scrap metals used in transportation vehicles and other equipment suggests that improvements in metal recycling technology might reduce transportation supply costs.**

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*See "Automobile Durability" (Miller), Volume 2.
**See Volume 6.

Table X-1

TRANSPORTATION ENERGY CONSUMPTION

A. Transportation energy consumption in relation to total domestic consumption:

Use	Basic Energy Source[a]		
	Petroleum	All Other[b]	Total
Transportation	16	nil	16[c]
Electric Power Generation	2	13	15
All Other Uses	12	29	41
Total	30	42	72

a. Entries are in 10^{15} Btu for year 1970.
b. Natural gas, coal, hydroelectric, nuclear.
c. See below, for distribution by mode.

Source: *Energy: Uses, Sources, Issues,* Lawrence Livermore Laboratory, 1972.

B. Transportation energy consumption by mode:

Mode	Percent of Total Transportation Consumption
Auto--Intercity	29.4%
Auto--Urban	32.0
Air	7.6
Bus	0.6
Rail	3.4
Truck	18.0
All Other	9.0
Total	100.0%

Source: High-Speed Ground Transportation Alternatives Study, DOT, 1973.

Recommendations

A program of research and technology development should be vigorously pursued to improve the fuel efficiency of all intercity transportation vehicles. An important aspect of this program should be to establish criteria for achieving a "balance" of efforts among modes and means of effecting this balance.

The potential results of current fuel conservation programs* should be evaluated with respect to environmental, economic, and financial impacts. The possibility of federal actions to assist in speeding the implementation of fuel-efficient technologies should be investigated.

Research on new materials for transportation vehicles should give increased consideration to improved materials for ground transportation. Techniques for disposal and recycling of materials should be an integral concern of these investigations. Research and technology development on improving the economics of scrap-metal recycling are sufficiently important to warrant continued significant effort.

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*NASA's aircraft fuel conservation program, for example.

XI. TRAVELER VALUES AND PREFERENCES

Travel demand analyses were conducted in this study to estimate patronage for future intercity transportation systems.* The quantitative methods that were used are judged to be representative of the current state-of-the-art in (1) predicting traveler choice among competing modes that have different performance attributes, and (2) forecasting total travel between two cities. As pointed out by study participants who reviewed the patronage results, and as recognized by the study team, a number of potential shortcomings of available intercity travel demand models are apparent:

- Only a limited number of transportation performance attributes can be explicitly treated--travel time, travel cost, and frequency of departures. Other attributes, such as perceived comfort, security, or convenience, must be included judgmentally,

- The models' weightings of modal performance attributes are suspect, especially when large changes in the attributes are postulated. For example, when it is postualted that speeds, frequency of departures *and* fares for rail service are doubled, very large increases in rail patronage and total travel (for all modes) are often obtained.**

- Only a limited number of factors are used to estimate total travel--population, income levels, and measures of the level of transportation service provided. Thus, a number of factors that may influence propensity to travel are ignored, e.g., amount of leisure and quality of communications.

Although substantial studies have been conducted to improve intercity passenger demand methodologies,*** these research efforts are judged less than adequate in comparison with similar efforts for urban travel.

Findings

An increased understanding of why people will elect to travel between cities and how travelers will choose among competing modes is essential

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*Volume 4.

**In such instances, it is clear that the models are being called on to estimate traveler choices in situations far different from those used to develop (calibrate) the models.

***Notably work in the Northeast Corridor Transportation Project and subsequent related work such as that by the National Bureau of Standards for DOT.

to support decisions regarding future intercity transportation research, investments, and service improvements. A starting point for this advance in knowledge is a better understanding of current traveler values and preferences--more comprehensive and higher quality data are needed.

Important data needs for all intercity modes include traveler choice criteria as they are influenced by trip purpose (business versus personal and pleasure travel), size of travel party (as a guide to how costs of travel would vary among modal options), age and income of the traveler, and types of origins and destinations (i.e., urban, suburban, and rural).

There is a related need for improved travel volume data. For the air mode (certificated carriers), city-pair data on passenger volumes are regularly published by the CAB. Comparable statistics are not published for commuter air, bus, or rail; current data on intercity auto travel volumes by origin and destination are virtually nonexistent. The U.S. Census of Transportation (1963/1967/1972) developed travel volumes (and traveler characteristics) for all modes of intercity transport, but the sample sizes are too small for reliable estimates of city-pair travel volumes by mode.

Recommendations

Continue studies to develop improved information on the preferences of various types of intercity travelers, encompassing all modes. Particular emphasis should be placed on the importance of comfort, convenience, and personal security relative to perceived cost and travel time, especially as these factors influence choice of mode for different travelers and types of trip and travel party sizes. Early steps in the project should include development of more comprehensive theories of choice and preference for travelers, supported by a small number of carefully designed, in-depth interviews with intercity travelers in selected categories. Later, choice models including variables such as suggested above should be postulated and calibrated to aid in intercity transportation planning.

A related study should investigate the feasibility and cost of an expanded and more detailed data base on intercity travel volumes by city-pair. This effort should, for example, explore the feasibility of publishing travel data for the rail and bus modes in a format similar to that currently provided for the air mode. The air mode statistics at the city-pair level might also be augmented with type of fare data and trip purpose information. Of particular importance is the need to develop improved survey procedures for the collection of intercity automobile travel data on a continuing basis.

XII. TRANSPORTATION FINANCE

Privately owned transportation equipment and facilities account for approximately 9% of total U.S. net private investment. About 14% of annual private expenditures for new plant and equipment are made in transport and related industries.*

A number of the issue papers developed in this study address questions and anticipated problems related to the financing of intercity transportation system improvements or new systems.** Unit capital costs (per mile, per vehicle) have been collected or developed for a number of transportation technologies,*** however, numerical estimates of total investment requirements for future intercity transportation systems have not been attempted in this study.

Findings

Issue papers and Workshop deliberations indicate that funding constraints will pose increasingly severe problems that must be solved before major improvements in intercity transportation systems can be made. This conclusion is based on such prospects as: continued increases in the costs of building, operating, and maintaining intercity systems; and scarcity of investment funds for transportation arising from steps to solve other major national problems, especially in the energy area.† Ameliorating the situation somewhat may be a reduction in funding requirements for such historically capital-consuming activities as schools (because of lower birthrates).††

Recently, a number of studies have been undertaken to estimate future overall levels of investment demand and supply.††† Most of these studies project serious deficiencies in the supply of capital over the next 5 to 25 years. Private sector investment in major intercity transporation system improvements is particularly vulnerable to a capital shortage because of high investment levels needed to maintain existing services. (Intercity transportation is generally more capital intensive than the rest of the economy.) To the extent that a capital shortage occurs and persists, strong emphasis will be placed on better management of existing intercity transportation resources and on incremental, low-cost system improvements.

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*_Transportation Facts and Trends_.
**Volume 2.
***Volume 3.
†See the Bruck paper in Volume 2.
††See the Ayres paper in Volume 2.
†††As cited in "Financial Issues Impacting Intercity Transportation" (Price and Luce), Volume 2.

To the extent that private venture capital is scarce, demands for government sector involvement in the financing of intercity transportation will increase. Intercession by government may occur in the form of new tax policies, grants or loan guarantees, subsidies, or direct public ownership.

In theory, government should assume an active role in financing intercity transportation when the capabilities of private-sector firms are not in consonance with public objectives. The public policy objective is to ensure that service levels meet public need. Thus, the nation may increasingly face "Who benefits?--Who pays?" questions about intercity transportation. Public programs may be required to strike a balance not only across the majority of political subdivisions, as in the past,* but also across influential interest groups defined along social or economic lines (the poor, aged, environmentalists, etc.). Legislation drawn along modal lines, such as highway, air, rail, or urban transit programs, seems increasingly unable to meet these distributional conditions.

In practice, government subsidy of intercity transportation has been used as a technique to avoid a total financial takeover by the public.* Arguments for public subsidies are frequently restricted to the needs of an individual mode; rarely considered is the possibility of providing equivalent or better service at equivalent or less cost by other modes. Compartmentalizing of public funding decisions, particularly in the legislative branch of government, may serve to perpetuate obsolete technologies and institutions.

Recommendation

Conduct a comprehensive study of funding requirements and sources for intercity transportation. The objective of the study would be to quantify short- and long-term financing needs in intercity transportation and to identify and evaluate possible funding mechanisms. The study should consider (1) public** and private sources of funds, and (2) transportation capital and operating/maintenance funding requirements. The evaluation of funding mechanisms should emphasize those that accomodate technology substitution, such as a combined transportation fund, and that use public funds to stimulate private investment.

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*See "The Congressional Politics of Transportation Expenditure" (Jones and Miller), Volume 2.

**Federal, state, regional, and local.

XIII. INSTITUTIONAL IMPACTS

Public and private institutions* combine in different ways to establish the services provided by intercity transportation systems. For example, in automobile transportation, vehicles are manufactured, bought, and operated by private-sector businesses and individuals, and highways are provided by government and financed largely by users; in commercial air transportation, vehicles are manufactured, bought, and operated by private-sector businesses on publicly provided airways and airports, financed primarily by users, with access and egress handled externally.

Findings

Institutional forces, rather than a lack of new technology options, are likely to constrain the introduction of new intercity transportation systems--especially those that would introduce major service improvements.

An impact of introducing new transportation technology is to cause changes in institutions or institutional relationships, but there is an inertia to these relationships that can serve as a formidable barrier to change. This situation will continue to be important in the future. Possibly one of the major emphases in planning of future transportation improvements should be to understand and deal more effectively with institutional forces.

Issue papers produced in the study** and discussions at the Workshop*** focused on varying "institutional problems" as they impact on transportation innovation and the process of technology delivery.

Transportation-supply institutions have been criticized as being slow to react to potentials for improvement, even when internally proposed. Independent institutions that provide components of a total transportation system optimize their own contributions, often to the detriment of overall system efficiency. For example, autos are designed with highway and driver capabilities assumed as given, while highways are designed with auto and driver capabilities given. No institution has the responsibility

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*The term "institutions" includes the many formal and informal organizations that supply transportation equipment and services. Included are those involved in setting government policies, in financing, in regulating transportation, and in influencing transportation to respond to environmental, user, or other interests.

**Volume 2; for example, "Constraints to the Implementation of Intercity Transportation Innovations."

***Volume 5, especially the reports by Panels 2 and 3.

for optimizing the highway, auto, and driving roles simultaneously. Altering the institutional arrangements that yield this suboptimization is very difficult, indeed.

The potential for innovation by transportation equipment manufacturers and commercial carriers depends heavily on private financial and insurance institutions. Concern was expressed regarding insurability (or the cost of insurance) of new high-performance transportation technologies (e.g., very large or fast aircraft and tracked levitated vehicles).

Another class of institutional problems deals with government as a policy setter, regulator, and funding source or guarantor. Both in the executive and legislative branches, and at the federal, state, and local levels, institutional forces can impede innovation. Regulatory agency positions, procedures, and precedents are not easily changed, even though criticism may be widespread. With regulatory agencies, as with policy-making and funding activities, institutional responses tend to be incremental and consensus-seeking--large changes are infrequent.

Recommendation

Undertake a program to enable R&T managers to more completely understand and evaluate institutional forces that may affect the implementation of new intercity transportation technologies.

One phase of the program would develop an analytical methodology for use by technologists to appraise institutional problems. It would provide a mechanism, such as has been developed for preparation of environmental impact statements, for tracing the potential events that would have to take place in the process of technology delivery, for identifying the institutions involved and their roles, and for highlighting critical institutional actions.

As background for the development of institutional impact methods, a detailed review should be undertaken of institutional forces that have had major impact on past transport technology programs. The airport and airway development program or the development of the AMTRAK system might be selected for this review. Both the positive and negative institutional forces should be identified and examined. Also, the economic, social, and environmental conditions and forces that existed over the time of planning and decision-making should be described and assessed to determine how they affected decisions.

A subsequent phase would appraise currently proposed technology programs to identify institutional forces that may influence their ultimate delivery. It is suggested that attention should be given to both major "hardware" innovations such as automated control of automobiles and major "software" innovations such as (as suggested in the Workshop) ticketing for door-to-door intercity common-carrier transportation.

XIV. REGULATORY CONTROLS

There are a number of types of regulation which apply to the provision of intercity transportation. Examples at the federal level include:

- Economic regulation of public modes by the Civil Aeronautics Board (certificated air carriers) and the Interstate Commerce Commission (intercity bus and rail freight).
- Safety regulation by DOT administrations (e.g., FAA, FRA, NHTSA).
- Nonindustry-specific regulation by the Environmental Protection Agency, the Federal Energy Administration, and the Occupational Safety and Health Administration.

At the federal level, antitrust and tax policies also serve to regulate intercity transportation. State and other government jurisdictions are also active in regulating components of intercity transportation services.

Several issue papers developed in this study explore varying aspects of transportation regulation, with emphasis on the prospects for and impacts of changes in economic regulation.* In addition, differing "regulatory futures" were an important element of the transportation scenarios analyzed in this project.**

Findings

Regulation has played, and will continue to play, an important role in both the development and control of transportation infrastructure and in the organization and operation of firms providing transportation services. Future changes in regulation will act as a barrier or spur to such factors as technological innovation, the speed of implementing new services, and the financial viability of transportation systems.

Currently, for all modes of transportation, there is a high degree of overlap in regulatory authority both among levels of government and among different bodies at the same governmental level. One effect of

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*Volume 2; particularly: "Constraints to the Implementation of Intercity Transportation Innovations," "Impacts of Regulation on Intercity Transportation," "Organizational and Regulatory Issues in Intercity Rail," "The Impact of Deregulation."

**Volume 4.

this situation is to pose a formidable barrier to the introduction of new large-scale or novel transportation innovations. Greater centralization of regulatory authority could alleviate this situation, but strong pressures--both for and against--make in unclear whether greater centralization will occur.*

Regulatory change may occur in the form of "deregulation"--that is, less restrictive or more "rational" control of price competition and entry/exit certification. Proponents argue that deregulation can improve quantities and qualities of transportation service and bring about lower costs. One opposing argument is that heightened competition will precipitate lower profits or even bankruptcy.** Viewpoints developed in this study about the impact of regulatory reform on R&T are also divided.

Some observers believe that less regulation will reduce R&T and eventual implementation of improved technology, since reduced profits will inhibit the ability and inclination to invest in new hardware. Others believe that less regulation will enhance R&T, saying for example, that the eventual rationalization of routes and service will produce the capability and incentive to introduce new technology better tailored to the service provided.

Cross-subsidization is certain to be a major reform issue. Some economists argue that cross-subsidies are undesirable because they do not permit the market to equate supply with demand. However, others view cross-subsidies as a tool of public policy because they allow for socially desirable transportation services to be provided in exchange for higher rates elsewhere. In this context, the issue is one of public policy toward economic efficiency versus social equity.**

While several alternative "regulatory-futures" have been identified in this study, a most-likely path of change has not been identified. Moreover, if the general economy goes through high growth/recession swings, patterns of regulatory policy may "reverse their field" several times, since the propensity to modify the regulatory process appears to relate to the economic climate of the times.*

Recommendation

Undertake a study to develop and apply methods of assessing possible regulatory changes and their impacts. Improved techniques are needed to analyze the effects of alternative economic, environmental, and safety regulations on levels of intercity service, transport industry structure, and technology development and implementation. The objective

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*"Issues in Regulation of Intercity Transportation," Volume 2.
**"The Impact of Deregulation," Volume 2.

of the effort should be to provide guidance on regulatory actions and R&T program priorities. The study should encompass all major modes of intercity transportation for both passengers and freight.

XV. OTHER RECOMMENDATION TOPICS

The recommendations on research and analysis tasks described in earlier chapters of this report address important intercity passenger transportation issues and impacts in the concensus of the project team. There are, however, a number of other explicit and implicit recommendation topics contained in the documentation of study tasks (Volumes 2 through 6).

A sampling of other recommendation topics is tabulated in this chapter. These topics have not been highlighted by the project team for one or more reasons. For example, the "transportation/communications tradeoff" topic listed in Table XV-1 is considered to be included within the more general recommendation on Traveler Values and Preferences in Chapter XI. As another example, the topic of "TLV designs for specific corridors" in Table XV-1 is considered to be premature in light of the findings for TLV set forth in Chapter VII.

Clearly, the selection of recommendation areas by the project team was a judgmental process. Given other perspectives, a different set of recommendation topics would have resulted. As evidence of this, the comments of study participants regarding the project team's selections are included in Appendix A.

Table XV-1

OTHER RECOMMENDATION TOPICS

Topic	Rationale
Explore innovative methods of automobile renting and leasing (e.g., "omni-rental") to make autos more broadly available for future intercity travel and/or improve traveler access/egress for the air, bus, and rail modes.	Specialization of auto designs for urban and intercity use may occur. Rentals would increase utilization and decrease costs for the intercity fleet. (Garrison, V-2)* The guarantee of an auto at origin and destination would improve access/egress for public modes (Panel 3, V-5)**
Evaluate, and implement if feasible, variable lane widths on multilane highway sections to improve traffic safety and/or increase capacity.	There is a trend toward smaller automobiles, while wider buses and trucks are desired by operators (Roggeveen, V-2). Different speed limits might be employed for buses and autos. (V-4)
Accelerate R&T efforts on the SST regarding noise and sonic boom, pollution, energy consumption, and operating costs with a view toward implementation on long distance domestic routes as well as international routes.	An (improved) SST would be a positive factor in increasing the community of interest between the United States and distant points such as the Far East (Panel 1, V-5). Many domestic air travelers might pay a premium for SST air service. (V-4)
Design tracked levitated vehicle (TLV) systems for specific high-density traveler corridors, with particular emphasis on access to the systems (e.g., station locations), in order to assess environmental, mobility and economic impacts.	To achieve political acceptability, a TLV system must provide service to all jurisdictions it traverses. Thus, relatively close spacing of stations or "rendezvous" systems that allow both easy access and uninterrupted high-speed line-haul service may be required. (Panel 4, V-5; V-6)

*V-2 is an abbreviation for Volume 2.
**Workshop reports for Panels 1, 2, 3, and 4 and special topic sessions are contained in Volume 5.

Table XV-1 (cont.)
OTHER RECOMMENDATION TOPICS

Topic	Rationale
Undertake R&T and operational studies of dual-mode intercity transportation systems which provide both convenient access/egress and line-haul economies.	Dual-mode systems such as advanced versions of auto-aboard-train services can provide flexible service, reduce problems at the "terminal interface" and may reduce energy consumption (Garrison and others, V-2). There are potential operational problems to be resolved (e.g., the discharge of "local vehicles" along the trunk route). (Panels 3 and 4, V-5)
Expand research on the needs and potentials for improved intercity transportation service to small communities. Bus and small aircraft services should be emphasized.	A growing aversion to "bigness" in all forms might lead to some future population dispersal (V-2). Low-fare buses and small aircraft services offer the potential for increased transportation service to small communities. (V-4)
Take steps to greatly improve traveler information systems to allow for ready comparison of modal options before making a trip and less confusion while under way.	More complete information is needed on travel options to assist in trip planning and better information displays are needed to guide travelers en route. (Panels 3 and 4, V-5; V-6)
Conduct new research on "the transportation/communications tradeoff" to identify how improved communications will impact on future volumes and patterns of intercity travel.	Improved communications may eliminate the need for some intercity trips but may also stimulate other travel. The net effect on intercity transportation is uncertain. (Jones, V-2)
Investigate the intercity transportation needs of the "disadvantaged"--the handicapped, the elderly, the poor, and the young--and improvements in services or facilities to meet these needs.	The disadvantaged constitute a large segment of society. There is need for more attention to intercity travel needs of the disadvantaged and the needs of the disadvantaged in rural areas. (Overby and Green, V-5)

Table XV-1 (cont.)
OTHER RECOMMENDATION TOPICS

Topic	Rationale
Develop improved techniques to assess the impacts of intercity transportation service levels on land use and development patterns.	Large changes in future intercity transportation service levels and facilities (e.g., TLV systems) would be likely to impact land use near terminals and rights-of-way and might also influence regional development. The importance of these impacts relative to other determinants of land use is not clear. (Panel 4, V-5; V-6)
Develop a systems analysis methodology capable of assessing the impacts of intercity transportation options at a national scale.	Case study techniques were used in this study to analyze transportation innovations. There is need to identify the national potential for implementation of proposed technologies and resulting national impacts such as financial requirements, energy consumption, and environmental effects. (V-4)
Focus additional attention on the transportation labor force as both a resource and constraint regarding future intercity transportation innovations.	Several study issues papers address aspects of the "labor problem" (V-2). Workshop attendees believe that more specific research is needed on labor implications related to advanced transportation systems development. (Panels 2 and 3, V-5)
Explore international implications related to progress in this country on transportation technology development.	National foreign policy interests and trade considerations will affect and will be affected by the rate of U.S. transportation technology development. (Panels 1 and 2, V-5)

Table XV-1 (concluded)
OTHER RECOMMENDATION TOPICS

Topic	Rationale
Give consideration to a major organizational change in the committee structure of Congress as it pertains to intercity transportation.	Several congressional committees have partial jurisdiction over matters related to transportation technology and service. More centralization or coordination appears warranted. (Jones and Miller, also Price and Greenstein, V-2)
Establish mechanisms to ensure that transportation R&T programs reflect national needs and, in particular, are sensitive to the process of technology delivery that follows research and development.	Institutional and political considerations, as well as mobility, environmental, and energy considerations need to be addressed in the structuring of R&T programs. (Gellman and others, V-2; Panel 3, V-5)

XVI. RECOMMENDATIONS CONCERNING THE STUDY PROCESS

This project has been one of several experiments in the use of "technology assessment" as a tool to assist in the formulation of research and technology objectives.* Among the experimental features of this project (particularly in combination) are the following:

- The study's broad scope--intercity passenger transportation (and interactions with freight service) to and beyond 2000 A.D.
- The use of scenarios to describe alternative future settings and intercity transportation development.
- The use of an industry (consultant)/university/government team to perform the study.
- The formation of a group of "study participants" from government, transportation and other industry, and academic institutions to review the progress of the project.

Given the experimental nature of the project, it is appropriate to comment on the design and conduct of the study. It is apparent that alternative project approaches might be employed in subsequent efforts of this kind.

An issue that bears directly on the design of technology assessment studies relates to intended results. It is generally agreed that a technology assessment should focus on "unanticipated secondary consequences" of an innovation. What is not clear, however, is the best starting point for such a search; namely, the amount of information that is needed on first-order effects of a possible innovation and the setting in which it will operate. There are questions concerning:

- the degree of detail in specifying technological, cost, and operating characteristics of an innovation
- the range of alternative settings that should be considered in assessing an innovation and the degree of detail used to describe each setting

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*Other technology assessments that have been sponsored by NASA include one addressing portable energy and one addressing large cargo aircraft.

- the amount of information needed on potential markets for an innovation (e.g., number of users and their characteristics)

The need for such specifics can be avoided by properly posed "what if..." questions. A danger, however, is to assume away the very impacts that are sought. On the other hand, too much effort can be devoted to analysis of direct impacts and not enough to the more difficult process of identifying unanticipated impacts. This aspect of technology assessment methodology should receive particular attention in forthcoming efforts.

Other project team observations regarding the study process are given in the series of findings and recommendations that follow.

Finding

This project's very broad initial scope made it necessary to continually review, and in some cases change, the focus of study activities in order to keep the effort within manageable limits. For example, as the study progressed, it became apparent that relatively little attention could be directed to freight transportation. It also became apparent that a time horizon of 20 to 25 years approaches an outer limit for useful technology assessment results; thus, relatively little attention was given to settings and impacts beyond that time frame. Nevertheless, the project's broad scope resulted in technology impact assessments of limited depth.

Recommendation

Before a large technology assessment is undertaken, consideration should be given to performing a preliminary short study or mini-assessment to focus on a set of specific and realistic objectives that can be accomplished within funding and time limitations.

In a transportation technology assessment, focus can be provided by limiting the analysis to technological options for a single mode (or perhaps two interacting modes) or concentrating on a limited number of travel markets, as defined by trip distances and traffic densities.

Finding

Even though the scope of a technology assessment might be carefully defined at the outset (as recommended above), it is important to provide for flexibility in project time schedules and resource allocation plans. Because a technology assessment deals with unanticipated impacts, it is likely that modifications to a work program will prove desirable as the project is under way to accomodate areas that were not

identified in project planning or areas which are found to have substantially more importance than was initially anticipated.

Recommendation

In planning technology assessment efforts, it should be recognized that the initial work program can only be approximate. The nature of such efforts mandates close coordination between project sponsors and those who perform the work.

Finding

The technology assessment process is interdisciplinary in nature and requires the participation of a wide range of industrial, academic, governmental, and other organizations.

Pursued to even a limited extent, the process uncovers a large number of diverse viewpoints among disciplines. This can lead to large amounts of documentation which render a comprehensive understanding of overall issues difficult.

The workshop concept employed in this study (and others) appears to have potential for bridging the "communications gap" among disciplines. In general, the most difficult problems are to focus workshop debates and then document these deliberations in a concise, yet complete, manner.

Recommendation

Continued study of and experimentation with the organization and conduct of workshops appears warranted. In particular, a better understanding is needed on what group deliberations can be expected to achieve. Concensus positions seem to be a natural outcome of workshops and these can be of value in supporting or redirecting study efforts. On the other hand, concensus can be sterile for purposes of a technology assessment. The prominent impacts that may actually accrue from a innovation might not be anticipated by any significant number of participants in a technology assessment.

Advanced communications techniques (e.g., the computer conferencing techniques that were used on an experimental basis among project team members in this study) might also be used to maximize communications among groups that are dispersed in terms of geography and interests.

Finding

The stress in technology assessment is largely on social science considerations--and not on technology *per se*. The study team found that

there is an apparent tendency to focus on negative attributes and uncertainties regarding technological innovations, rather than positive impacts.

Recommendation

Care should be taken to assure that the social considerations of a technology assessment are otherwise balanced by factors included in more conventional analyses of a technology, including those associated with efficiency criteria and market behavior.

Finding

It is possible that the output of a technology assessment can help establish research and development priorities for public agencies but it is not appropriate for a technology assessment itself to determine such priorities. No technology assessment can possibly identify, much less analyze, all of the subsidiary impacts from the successful exploitation of technological options. For this reason alone, technology assessment can only support the development of R&D priorities.

Recommendation

It is important to determine the extent to which the output of technology assessments should be used in establishing R&D priorities in public-sector technology development programs. While it is clear that no technology assessment can provide all the inputs necessary to establish these priorities, it is also clear that the extent to which technology assessments should be relied upon in establishing priorities has not yet been determined with any degree of precision.

Finding

At the time a technology assessment is conducted, certain issues will be the topic of much general discussion. Contemporary examples include future energy availability and prospects for regulatory reform. The currently "popular" issues are likely to receive a great deal of attention in the technology assessment and heavily influence results. As time passes, the issues may prove less (or more) critical than anticipated during the technology assessment.

Recommendation

To the extent that technology assessment results are used in formulating R&D plans and programs, these results should be regularly reviewed and modified on the basis of changing conditions.

Appendix A

COMMENTS BY STUDY PARTICIPANTS

Appendix A

COMMENTS BY STUDY PARTICIPANTS

A group of 40 invited "study participants" contributed to this project by attending the Workshop and commenting on draft reports. The group included representation from federal, state and regional government; transportation and related industries; academic institutions; and other organizations.

A draft of this "Study Recommendations" report was distributed to the study participants for review and comment. Many of the responses were used by the project team to modify the draft text. Other comments are included in this Appendix, primarily to convey the diversity of viewpoints that were identified during the project. These study participant comments have been arranged (and in some cases paraphrased) to follow the chapter organization of the main body of this report.

It is emphasized that viewpoints presented are those of the study participants and not necessarily those of their companies or agencies.

Intercity Automobile Transportation

The chapter gives a brief but realistic assessment of the role of the automobile in the present and in the future. The auto is projected to maintain its dominance of intercity travel to the year 2000 although with a possible lessening of its dominance if the current trend toward smaller autos continues. The most vulnerable aspect of the auto, however, is its fuel consumption, and the recommendation to pursue research and technology development of more fuel efficient autos is clearly correct.

George Broderick
Federal Highway Administration

The recommendations do not appear to take stock of other government-sponsored efforts, e.g., the transportation research programs of the Energy Research and Development Administration (ERDA) and the deliberations of the Interagency Task Force on Motor Vehicle Goals Beyond 1980.

William Sprietzer
General Motors Corporation

In Findings on the Auto nothing is made of the fact that the auto is one system that can accept incremental change well. Unlike most intercity transport technologies, a mix of innovations can be utilized without incompatibilities, and the losers weeded out without undue capital loss.

Edwin Haefele
University of Pennsylvania

The dominance of the auto does indeed arise from the low perceived cost. This low value is caused by unusually costly roadways paid for by distortions in the transportation resource pool. This mode is then abused and the roadways treated as a free good. Further subsidization of this mode may not be in the national interest due to the unpleasant side effects such as pollution and energy consumption.

While some undesirable characteristics exist in the auto, it must not be altered to the extent that the roadway cannot be used by its replacement. The value stored in the roadway is too great to be lost. Any rational consideration of the proportion of our energy pool which should be logically available for transportation would, I believe, find 22% of all energy and 53% of all petroleum energy used by the auto too great a proportion of the totals.

Harold Roland
University of Southern California

There are several possible economic justifications for a public role in research and technology development. One of these is that the government is better able to pool risks. Where the scale of the effort and probability of failure is very great relative to firm size, there may well be legitimate grounds for public financing of R&D. In this sense the study recommendations that government efforts in automobile propulsion systems (and aircraft airframe and engine development) should concentrate on high risk options has some obvious theoretical justification.

Nonetheless, this formulation, stated without qualification, arouses some concern. The findings do not document the case that risks are of such magnitude relative to firm size that serious misallocation of R&D effort will result. Nor is there consideration of the possible arrangements for private risk pooling consortia.

There is a need to make the rationale explicit because it has been misused in the past to justify government involvement in projects that were simply imprudent. After all, no amount of pooling of bad risk will produce positive net benefits. Thus, the absence of private interest in a project because of "risk" does not in itself indicate the likelihood of a market failure or a justification of government investment. In the specific case of the automobile industry it appears particularly improbable that the firms are incapable of bearing the risks of a diverse propulsion technology research program.

Leonard Lee Lane
Public Interest Economics Foundation

Intercity Bus Service

Being associated with the intercity bus field, I feel a most urgent need today is to permit the size of the coach to increase (particularly in width) to afford passengers additional comfort. An existing double seat in a bus must of necessity be only 38 inches wide to accomodate two passengers. With a regulation for a 14-inch aisle one can readily

see no additional comfort can be obtained until coach width is increased through regulations.

Also, a higher speed would substantially reduce travel time and make the bus much more competitive with the automobile. Certainly this can be justified based on comparative energy consumption where the diesel-powered bus is by far the most energy efficient mode of transportation.

We feel that variable lane widths on multilane highway sections to improve traffic safety and capacity are feasible immediately with regulatory approval. Creation of a wider lane exclusively for buses and trucks would greatly facilitate movement of passengers and freight and this could be done with existing equipment with wider and perhaps longer equipment phased-in in the near future.

Intercity transportation needs for the "disadvantaged," the handicapped is another area that required additional studies. In the intercity field, because of the width limitations of an intercity bus it is virtually impossible to handle a wheel-chair passenger. Recently most intercity carriers have initiated a program where a disabled person or handicapped person is allowed to take a companion at no charge as long as the companion is capable of assisting the handicapped person. This is the best approach to at least offer handicapped persons the opportunity to travel intercity on a bus with no penalty for their companion. This was introduced in 1975 and was enthusiastically received by the handicapped passengers.

J. G. Stieber
Greyhound Lines, Inc.

The intercity bus recommendations should not overlook the potential for taxi and limousine service on a flexible schedule basis, as opposed or in addition to regularly scheduled service. Much greater emphasis should be placed on terminal location, with suburban terminals emphasized and interconnected to urban transit service. The development of improved traveler information systems should be stressed.

George Wickstrom
Metropolitan Washington Council
of Governments

I vigorously protest the incorrect numbers shown in this Chapter on energy efficiency by mode. I suggest that you use the following table:

	Thousands of BTUs per Passenger Great Circle Mile at 500 Miles
Auto	3.5 - 6.0
Bus	0.8 - 1.6
Rail	2.0 - 9.0
Air	5.0 - 9.0

Note: 60% load factor assumed for public modes.
Survey load factor for autos.

This data is derived from our report, "Intercity Passenger Transportation Data Energy Comparisons," D6-41814, Vol. 2, May 1975, using 135,000 BTU/gallon as conversion. This data was presented all over the country, to universities, rail, highway and air interests and withstood detailed scrutiny.

Gerardus Schott
Boeing Commercial Airplane Company

Air Transportation

Great strides can and will be made in aircraft noise reduction. Data generated for the NASA Refan Program quantitatively supports this statement and further technical improvements will be made. There *is* an implementation problem; namely, the cost of changing over to the new technology in the light of the large fleets of relative young low-bypass-ratio powered airplanes.

Gerardus Schott
Boeing Commercial Airplane Company

An additional advance in air technology that should be added is the compound be added is the compound helicopter. This vehicle is sufficiently different from the short-field aircraft that it should be separately identified.

Harold Roland
University of Southern California

Electric/Automated Highways

I was very surprised to see the positive recommendation that there be technical studies on the question of electrified/automated highways. My readings of the study reports and my participation at the Workshop had led me to the conclusion that electrified highways were an improbable technology at best. It would seem that only the combination of the circumstances of extensive capital availability, extensive development of alternative electrical generating capabilities (probably nuclear), and severe shortage of fossil fuel-type energy could lead to the use of electrified highway technology. The probability of the occurance of these circumstances in concert I believe would be quite remote.

Robert Best
California Department of Transportation

The probability that the electric/automated highway would prove to be cost effective by the year 2000 seems low. A capital shortage for highway construction, maintenance, and operation exists and may be expected to persist. When this is coupled with the fact that most auto travel occurs within 10 miles of home on roads and streets unlikely ever to be automated, the probability seems remote that enough auto purchasers would pay the high cost to equip their cars with the necessary

command and control devices for automated highway use to even approach cost-effectiveness for the automated system.

George Broderick
Federal Highway Administration

Electric/automated highways involve tremendous capital costs and allocation of capital for this purpose will mean that less capital is available for other purposes. These other purposes might be more socially desirable or more in line with national goals. Hence, there is a tradeoff here which is not mentioned--and I think it should be. After all, we must think of social-cost-effectiveness, not just "cost-effective" technology.

Melvin Kranzberg
Georgia Institute of Technology

I feel that the findings on the Electric/Automated Highway are "too far out." It is inferred that automobiles will merely enter a check-out gate and then be propelled automatically, with safe headways, down the highway by an imbedded electric propulsion system. Realistically, many difficult technical and safety problems must be solved before this can be given serious consideration. A very key one is the achievement of *extraordinary high reliability* of the system (either if the vehicle operates on its own rubber tires or on special pads) in order to prevent a guideway blockage by a single "dead" vehicle. I personally believe this concept should be a development or an exploitation from the autotrain, at least for the time period we addressed.

Walter Hesse
Rohr Industries, Inc.

This mode should be studied carefully because it offers a significant improvement in present systems while utilizing the value stored in the subsidized roadways. Comparisons and priority rankings with present or existing systems should always consider this point of commonality.

Proceeding concurrently with the technical study of the electric highway should be a study of relative value of this mode. The value should be developed in the light of possible selective use of such a mode on a limited set of routes.

Harold Roland
University of Southern California

Access/Egress and Intermodal Transfer

The section is, in my opinion, "right on the money" and deserves top priority. The institutional barriers to implementation will remain, however, unless a parallel program of research into this area is carried on as well.

George Wickstrom
Metropolitan Washington Council
of Governments

The statement is made that some intercity buses are not allowed to serve the airport. And reference is made to the Overby and Best paper in Volume 5 which in turn, states "Major intercity bus companies provide service to Chicago from such places as Rockford, Illinois, Milwaukee, Wisconsin and hosts of small communities to the north and west of Chicago. In doing so, they pass right by O'Hare International Airport each day with many buses. These buses are not permitted to pick up or discharge passengers at O'Hare." However, Russell's Official Bus Guide shows that 58 intercity buses provide daily service between O'Hare and Rockford, South Bend, Gary, Hammond, Kenosha, Racine, and Milwaukee. The services are provided by the Peoria-Rockford Bus Company and by Tri-State Coach Lines, Incorporated. Possibly there is some definitional problem--e.g. what is a major intercity bus company.

George Broderick
Federal Highway Administration

Transportation Finance

I note that a study of the sources of funding for intercity transportation capital requirements is recommended. We and several other insurance companies question the ability of public service transportation companies to raise any significant amounts of capital from private sources.

James Goodridge
Connecticut General Life
Insurance Company

Governmental funded development of new modes of travel or significant improvements in the present modes, must be approached very conservatively, with an application of limits on the true requirements of the population. It should be recognized that the new modes may be employed selectively on city pairs for which they are uniquely suited by virtue of the distance, demand, or other travel descriptors.

Harold Roland
University of Southern California

Institutional Impacts

I strongly agree with your statement that "Institutional forces, rather than lack of new technology options, are likely to constrain the introduction of new intercity transportation systems..." Ever since the term "technology assessment" appeared on the scene I have been suggesting the need for "Institutional Assessment." I would suggest that you broaden the concept to include more than just institutional assessment. Perhaps something like "Social and Institutional Impact

Assessment" more adequately addresses the full range of forces with which R&T managers will need to become conversant.

Charles Overby
Ohio University

One of the study's strongest aspects is its recognition of the importance of regulatory and other institutional factors. A better understanding of their impact on transportation technological change is a prerequisite for developing realistic R&D priorities. This conclusion is especially true in light of what appears to be improved prospects for modifying regulatory and public finance policies that may have caused serious distortions in patterns of technological change.

At least two aspects of this issue warrant some further elaboration. The first is discussed by the study. It is the problem of institutional barriers to innovation. There should, however, be more explicit recognition that such barriers may be the result of a governmental failure to act, or of action in apparently unrelated policy areas. It is only when the full scope of this problem is explicitly recognized that its great significance becomes manifest. Second, although the study refers to artificial institutional retardation of technological change, it does not address the issue of institutionally induced demand for unneeded or unjustifiably accelerated technological change. There is, however, evidence that such change has sometimes occurred, and it must inevitably waste resources.

Leonard Lee Lane
Public Interest Economics Foundation

I suggest that several new forms of institution be examined for the single purpose of implementing a new intercity system. This institution would "mother" the project from "cradle to grave" and it should encompass all the political, environmental, financial, and technical aspects of a project. It may well be that our current set of organizations and political entities are insufficient to accomplish a new intercity transportation system. The highway trust fund is an institution that has been most successful, but what organization or institution is optimum for new transportation systems? Is a COMSAT for transportation required? I suggest that a new institution may be the best or the only solution and, therefore, I believe such a concept be included as a recommendation. One such transportation institution that I am familiar with is in Canada and is called the Urban Transportation Development Corporation (UTDC), a quasi-government entity which has been specifically created to develop new urban transportation systems, both conventional and novel, and then sell these systems throughout the world. Even though this example is for urban transit systems, it should be looked at as a possible model for an intercity solution.

Walter Hesse
Rohr Industries, Inc.

Regulatory Controls

I endorse the recommendations for "regulatory controls." Recent efforts to measure the effects of regulation have varied widely in results, have in some instances used questionable techniques and data, and accordingly have produced considerable controversy.

Edward Margolin
American University

It seems to me that regulatory policy is the single most important institutional barrier to cost effective implementation of various transportation alternates.

Fred Kant
Exxon Research & Engineering Company

Other Recommendation Topics

I was a bit disappointed to see the idea of public traveler information systems relegated to an "Other Recommendation Topic." Obviously, improved information systems are not going to be a panacea but I believe we underestimate the magnitude of the barrier that our present information systems present to a more effectively utilized total public transportation system. I am happy to see that the information need does surface as a component in some of the major recommendations such as "Access/Egress and Intermodal Transfer" and "Improved Intercity Bus System and Service."

Charles Overby
Ohio University

I would like to make two points which I believe give traveler information systems a higher degree of importance than is represented by the final report.

1. Our present stage of development in this area is about as crude as one can be in a modern civilization. We would appear to have substantial opportunities for large incremental improvements by just adapting for use already existing technologies is support areas (e.g., electronics).

2. Many of us in the day-to-day world of administering transportation programs have concluded that the most significant improvements in transportation in the predictable future will come from making better use of essentially what we have today. One of the biggest shortcomings we have today is our ability to get information to the user on how to select appropriately

and to use effectively the transportation alternatives which are available to him.

Robert Best
California Department of
Transportation

Two other recommendation topics should be included. (1) The role of general aviation with regard to access/egress, aircraft technology, and traveler values and preferences deserves additional attention. (2) The organizations that will be expected to implement new transport technologies should be examined. The motivation to adapt, implement, and invest in new technologies depends on the incentives and risks to managements of these organizations. Management of investor owned transportation companies can be expected to act differently from government sponsored, financed, and controlled entities such as AMTRAK and ConRail.

James Goodridge
Connecticut General Life
Insurance Company

The Study Process

I wonder if the area chosen for a technology assessment wasn't simply too large to manage. Automobile manufacturers seem to have difficulty in predicting what size car Americans want to drive next year. Thus it should not surprise us that we found difficulty in looking at all of intercity transportation. This broadness of reach tended to dilute the debate at the Workshop and the result shows in the Report. The well-informed members of the group on each individual subject must feel frustrated that the depth of their knowledge did not survive the process.

Grant Thompson
Environmental Law Institute

I have a feeling that the Technology Assessment (TA) to a large extent dwells on negative impacts of intercity passenger transportation. There is a crying need to develop insights in the benefits, and to develop yardsticks to measure those benefits. Only then will a TA be able to present a more balanced picture of the technology impact.

Gerardus Schott
Boeing Commercial Airplane Company

General Comments

After first reading my conclusion was that the report didn't say anything. Then I read it carefully the second time and decided it said a great deal, though perhaps in a form that was too condensed and at the same time too general.

I was happy to see that some good consumer input is included, like the recommendations on studies on attitudes, linkage between the modes, and multi-modal terminals.

Juanita Greene
The Miami Herald and DOT--
Office of Consumer Affairs

I have an overall impression that the report is unduly tentative, calling for research when it could be saying, regardless of where the future falls within large ranges, the outlook is thus and so...

In the area of the auto, for example, it was clear at the Workshop and in the Working Papers that it would take very severe and unlooked for upheavals to change our basic dependence on the auto. Yet the report speaks of the many things we do not know, the need for more studies, etc., in the very area where the findings are most clear.

Edwin Haefele*
University of Pennsylvania

Technology assessment (TA) in business, industrial, and commercial settings is a tool for sharpening a company's internal policies and RD&D, strategies for profit maximization. In these cases, a TA must contain firm recommendations. TA in a government environment is, instead, the definition of technology futures and assessment of their consequences on society. The study should not result in a repetition of the existing, well-documented lists of technology needs for enhancing intercity transportation, but rather an assessment of social impacts.

George Hoffman
University of Southern California

Many of the recommendations will involve outlays of substantial sums of money. Unfortunately the contemporary socio-economic-political climate does not appear sensitive enough in many of these areas. This suggests a need to articulate with citizens in new and creative ways so that it is politically and economically more easily possible to continue long-range studies so that when we reach the year 2000 it will not take a wasteful crash program to cope with some impending transportation crisis.

Charles Overby
Ohio University

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*This view was also expressed by other study participants.

Appendix B

OTHER FINAL REPORTS

Appendix B

OTHER FINAL REPORTS

Volume 1: Summary Report

A condensed (30-page) description of project activities and results.

Volume 2: Identification of Issues Affecting Intercity Transportation

Contains 22 papers prepared by individuals representing diverse backgrounds and interests. Most of the papers address mechanisms which will influence the way that transportation technologies will evolve and be put into service.

Volume 3: Technological Characteristics of Future Intercity Transportation Modes

Describes the future performance characteristics of present intercity modes and possible new forms of intercity transportation. The report includes sections on air transportation, high-speed rail, tracked levitated vehicles, highway transportation, and other ground transportation concepts.

Volume 4: Study Scenarios

Presents an analysis of intercity transportation options to the year 2000. The report includes a description of four alternative transportation scenarios and their associated background scenarios.

Volume 5: Workshop Proceedings

Documents the results of the project's one-week Workshop which was attended by the project team and 40 study participants. The volume includes the reports of four panels and several "special topic sessions."

Volume 6: Impact Assessment

Traces the potential consequences of a variety of postulated innovations in the air, rail, and highway modes. Attention is given to both direct and indirect impacts of technological changes in intercity transportation.